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PATENT
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IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicant:	Jan STENSBORG et al.		
Appl. No.:	09/471,393	Group:	Unassigned
Filed:	December 23, 1999	Examiner:	UNASSIGNED
For:	A METHOD FOR REPLICATING A SURFACE RELIEF AND AN ARTICLE FOR HOLDING A SURFACE RELIEF		

LETTER

Assistant Commissioner for Patents
Washington, DC 20231

January 11, 2000

Sir:

Under the provisions of 35 U.S.C. § 119 and 37 C.F.R. § 1.55(a), the applicant(s) hereby claim(s) the right of priority based on the following application(s):

Country	Application No.	Filed
DENMARK	PA 1998 01745	December 30, 1998

A certified copy of the above-noted application(s) is(are) attached hereto.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fee required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

By _____
John A. Castellano, #35,094

P.O. Box 747
Falls Church, VA 22040-0747
(703) 205-8000

JAC/jm
459-386P

Attachment

459-3868
J. Stenstorp et al
09/471,393
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BSKB
205-8000

Kongeriget Danmark

Patent application No.: PA 1998 01745

Date of filing: 30 December 1998

Applicant: Glud & Marstrand
Hedenstedvej 14
DK-8723 Løsning

This is to certify the correctness of the following information:

The attached photocopy is a true copy of the following document:

- The specification, claims and drawings as filed with the application on the filing date indicated above.

Patent- og Varemærkestyrelsen
Kongeriget Danmark

Patent- og
Varemærkestyrelsen
Erhvervsministeriet

Taastrup 30 December 1999

Karin Schlichting
Head Clerk

A METHOD FOR REPLICATING MICROSTRUCTURES ONTO A METAL SUBSTRATE AND A SYSTEM FOR HOLDING MICROSTRUCTURES

FIELD OF INVENTION

The present invention relates to a method for replicating microstructures onto a metal substrate. In particular, the invention relates to a method for depositing onto the metal substrate a non-metallic layer. Microstructures such as holograms are subsequently formed in the non-metallic layer by an embossing process. Further, the present invention relates to a system fabricated using the above-mentioned method. Even further, the present invention relates to an apparatus for carrying out the above-mentioned method.

BACKGROUND OF THE INVENTION

The use of holograms as a means to protect printed materials and other products against counterfeiting have gained wide acceptance in industry today. Holograms are used also as decoration on printed materials, in particular packaging. Holograms are either applied as labels or by hot-embossing of holographic foils.

Applying a hologram to a metal, none of the above mentioned methods are practical for the following reasons:

- the methods are costly in production and the cost of each item is high. Also, there are limitations in the choice of materials, and the durability of these materials is low, and

- there may be esthetical as well as security reasons for not choosing this method.

US 4,725,111 and US 4,773,718 pertain to processes of embossing holograms directly into a metal surface, preferably aluminum. However, embossing of holograms directly into metal is very difficult due to the hardness of the metal surface.

It is a disadvantage of the above-mentioned processes, that in order to soften the hardness of the metal surface the process takes place at elevated temperatures so as to reduce the hardness of the aluminum.

US 4,900,111 deals with embossing on a hard metal. The hard metal is coated with a soft metal layer, preferably tin. US 5,193,014 describes how to emboss a simple diffraction grating into the bottom of a tin can. This procedure makes it possible to use the grating as a pressure gauge when the can is filled with beverages.

It is a disadvantage of all the above-mentioned techniques, that relatively high pressure is required in order to press the embossing tool into the material in question.

It is an object of the present invention to provide techniques for replicating microstructures into a broader range of materials, preferably non-metallic materials.

It is a further object of the present invention to provide techniques for replicating microstructures without applying a high pressure to the embossing tool.

It is a still further object of the present invention to provide techniques for replicating microstructures at ambient temperatures.

The above-mentioned objects are accomplished by providing a method for replicating microstructures onto a metal substrate comprising the steps of:

- depositing onto the metal substrate a first layer of non-metallic material, and

- pressing into the non-metallic layer an object comprising a surface so as to change the surface properties of the non-metallic layer in order to replicate at least one microstructure, said at least one microstructure forming part of the surface of the object.

The non-metallic material may be an organic coating, such as a lacquer film or a polymer. By changing the surface properties is primarily meant changing the surface topology of the non-metallic layer. The induced changed may be evaluated by scanning probe techniques, such as atomic force microscopy (AFM).

The deposition of the non-metallic material and the changing of said non-metallic material is performed during essentially the same process. By essentially is meant within a time period of a few minutes. The surface changes are essentially permanent over time. By essentially permanent is meant that the changes are stable over a period of at least 12 months.

The at least one microstructure forming part of the surface of the object may be a diffracting element, such as a hologram. The diffracting element is preferably fabricated from a refractory material. Alternatively the surface of a microstructure fabricated from a non-refractory material may be hardened so as to reduce the wear of the surface.

The thickness of the first non-metallic layer deposited onto the metal substrate is in the range 1-50 μm, preferably in the range 2-25 μm, more preferably in the range 2-20 μm, even more preferably in the range 5-15 μm, such as in the range 5-10 μm.

The above-mentioned objects are further accomplished by providing a system for holding microstructures, said system comprising:

- a metal substrate being adapted to be coated with a first layer of non-metallic material, and

- a first layer of non-metallic material which is deposited onto the metal substrate, said first layer being adapted to hold microstructures.

The system for holding microstructures is preferably fabricated according to the above-mentioned method. The metal substrate may be essentially plane or the metal substrate may be curved.

Further, an apparatus for carrying out the above-mentioned method is provided, said apparatus comprising:

- means for moving and holding the metal substrate,

- means for depositing onto the metal substrate the first layer of non-metallic material, and

- means for pressing into the non-metallic layer an object comprising a surface so as to change the surface properties of the non-metallic layer in order to replicate at least one microstructure, said at least one microstructure forming part of the surface of the object.

BRIEF DESCRIPTION OF THE DRAWING

Figure 1 shows the system according to the present invention. The system comprises a metal substrate and a non-metal coating deposited onto the metal substrate.

Figure 2 shows the apparatus for carrying out the method according to the present invention. The apparatus comprises means for moving and holding (carrier roll) the system and means for embossing (replicating roll) microstructures, such as holograms, into the system.

Figure 3 shows an AFM picture of a microstructure.

Figure 4 shows an AFM picture of a metal substrate carrying the replicated microstructure.

DETAILED DESCRIPTION OF THE INVENTION

Referring to figure 1, the system according to a preferred embodiment of the present invention is shown. The system comprises a metal substrate which, in figure 1, is shown as a plane substrate. However, the substrate may also be curved. The substrate is adapted to hold a non-metallic coating such as an organic material.

In another embodiment, now referring to figure 2, the present invention also pertains to a method for replicating a microstructure, such as a hologram, onto a metal substrate. Preferably, the microstructure is an integral part of the replicating tool.

Preferably, the embossing will take place as an integral part of the colour printing process in the manufacturing process used in the production of metal containers already. In this way, cuts and saving in production time and resources can be achieved. Last but not least, the hologram will appear to be an integral part of the product, i.e., an integral part of a metal container. This gives a more uniform design of the metal substrate and protects it against counterfeiting.

The carrier roll is adapted for holding and moving the system according to the invention at least during part of the embossing process.

The application of a diffracting element, such as a hologram, directly into the metal opens up new methods for graphic design on metal containers. Subsequently the above-mentioned standard procedures like foil and hot-embossing become obsolete.

AFM pictures of a microstructure, the surface of a compact disc, and a metal substrate carrying the replicated microstructure are shown in figure 3 and 4, respectively. The capability of the method for replicating small details with high spatial resolution is evident from the two AFM pictures.

CLAIMS

1. A method for replicating microstructures onto a metal substrate comprising the steps of:

- depositing onto the metal substrate a first layer of non-metallic material, and

- pressing into the non-metallic layer an object comprising a surface so as to change the surface properties of the non-metallic layer in order to replicate at least one microstructure, said at least one microstructure forming part of the surface of the object.

2. A method according to claim 1, wherein the non-metallic material is an organic coating.

3. A method according to claim 2, wherein the organic coating is a lacquer film.

4. A method according to claim 2, wherein the organic coating is a polymer.

5. A method according to any of the preceding claims, wherein the deposition of the non-metallic material and the changing of said non-metallic material is performed during essentially the same process.

6. A method according to any of the preceding claims, wherein the surface changes are essentially permanent over time.

7. A method according to any of the preceding claims, wherein the at least one microstructure forming part of the surface of the object is a diffracting element, such as a hologram.

8. A method according to claim 7, wherein the diffracting element is made of a refractory material.

9. A method according to any of the preceding claims, wherein the thickness of the first layer deposited onto the metal substrate is in the range 1-50 μm.

10. A method according to claim 9, wherein the thickness of the first layer deposited onto the metal substrate is in the range 2-25 μm.

11. A method according to claim 10, wherein the thickness of the first layer deposited onto the metal substrate is in the range 2-20 μm.

12. A method according to claim 11, wherein the thickness of the first layer deposited onto the metal substrate is in the range 5-15 μm, preferably in the range 5-10 μm.

13. A system for holding microstructures, said system comprising:

- a metal substrate being adapted to be coated with a first layer of non-metallic material, and

- a first layer of non-metallic material which is deposited onto the metal substrate, said first layer being adapted to hold microstructures.

14. A system according to claim 13, wherein said system has been fabricated according to any one of claims 1-12.

15. A system according to claim 13, wherein the metal substrate is essentially plane.

16. A system according to claim 13, wherein the metal substrate is curved.

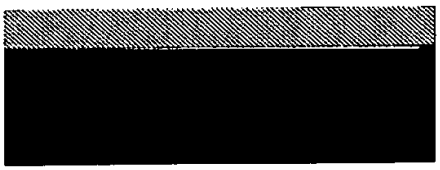
17. An apparatus for carrying out the method according to any of the claims 1-12, said apparatus comprising:

- means for moving and holding the metal substrate,

- means for depositing onto the metal substrate the first layer of non-metallic material, and

- means for pressing into the non-metallic layer an object comprising a surface so as to change the surface properties of the non-metallic layer in order to replicate at least one microstructure, said at least one microstructure forming part of the surface of the object.

Fig. 1



Non-metal coating

Metal substrate

Fig. 2

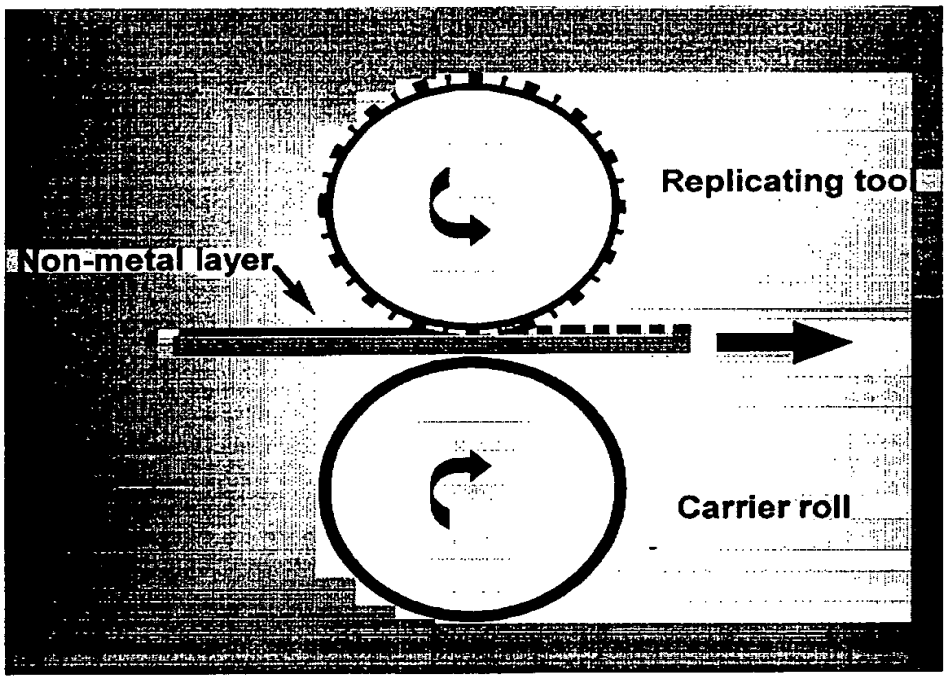


Fig. 3

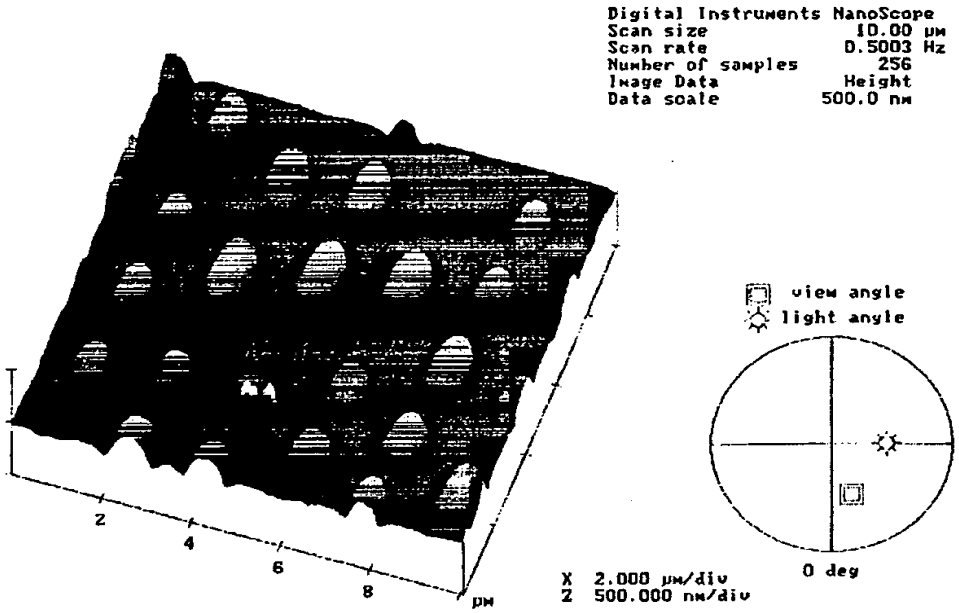


Fig. 4